Minor Degree in Mechanical Engineering

STUDY SCHEME & SYLLABUS

(From the Academic Year 2022-23 Onwards)

BOARD OF STUDIES

DEPARTMENT OF MECHANICAL ENGINEERING
SANT LONGOWAL INSTITUTE OF ENGINEERING & TECHNOLOGY
(Deemed to be University under Ministry of Education, Govt. of India)
Longowal – 148106 (Punjab) INDIA

Study Scheme of Minor degree in **Mechanical Engineering**

Sr. No	Semester	Course code	Course name	L-T-P	Credits
1	4th	MDME -521	Engineering Materials & Manufacturing Processes	3-1-0	4
2	5th	MDME-611	Thermal Engineering and Fluid Mechanics	3-1-0	4
3	6th	MDME-621	Fundamentals of Mechanical Design	3-1-0	4
4	7th	MDME-711	CAD/CAM & Robotics	3-1-0	4
5	8th	MDME-721	Industrial Engineering	3-1-0	4

Title of Course : **Engineering Materials & Manufacturing Processes**
Subject Code : **MDME -521**

L	T	P	Credits	Weekly Load
3	1	0	4	4

COURSE OUTCOMES:

Upon successful completion of the course, the student should be able to:

CO1: Understand the importance of engineering materials and their engineering applications.

CO2: Select a suitable material for industrial applications and product development based on composition and properties.

CO3: Demonstrate and practice the various types of manufacturing processes and should be able to identify their industrial applications.

CO4: Use modern tools for understanding and problem-solving aspects of the non-conventional machining processes and additive manufacturing techniques.

CO5: Exercise teamwork, lifelong learning, and serving society while taking the projects from the said course.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation):												
COs	**Programme Outcomes (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	2	2	1	1	1	2	1	2
CO2	3	3	3	2	2	2	2	2	2	2	2	2
CO3	2	3	3	3	3	2	2	2	2	2	1	2
CO4	2	3	3	3	3	3	2	2	2	2	2	2
CO5	2	2	2	2	3	3	3	2	3	2	3	3
Avg.	2.4	2.6	2.6	2.4	2.6	2.4	2	1.8	2	2	1.8	2.2

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-I	**Metals, and Non-metals**	**Ferrous, Non -ferrous Metals & their alloys:** Iron, Aluminium, Magnesium, Titanium, Copper and their alloys: Properties, Selection and applications. **Non-metals:** Thermoplastics Polymers, Thermosetting Polymers; Elastomers; Rubbers and Specialty Rubbers: Properties, Selection and applications.	**07**
	Composite Materials and Ceramics	**Composite Materials and Processes:** Classification of Composite: metal-matrix, ceramic–matrix, and polymer matrix composites; selection and applications. **Ceramic Materials:** Ceramic structures, ceramics processing; Properties and applications.	**07**
	Techniques for Improvement of Material Properties	**Surface modifications techniques**: Metal spraying, cladding, hardfacing and build up etc. **Heat Treatment**: Principle, types and applications	**10**
Unit-II	**Conventional Manufacturing Processes**	**Metal Forming:** Metal forming operations & uses such as Forging, Rolling, Wire & Tube-drawing/making, Extrusion, and their principles/applications. Pressworking operations and its applications. Hot-working versus cold-working. **Machining:** Basic principles of Lathe-machine and operations performed, Basic description of machines and processes of Shaper-Planer, Drilling, Milling and Grinding.	**08**

		Casting: Pattern & allowance, Molding sands, Mold making, Gating system, Introduction to various casting process, Casting defects & remedies.**Welding:** Basic concepts of welding, classification of welding processes. Gas-welding, types of flames, Electric-Arc welding, Resistance Welding. Soldering & Brazing and their applications.	**08**
	Non-conventional Manufacturing Processes	**Introduction, principle, and applications**: Ultrasonic Machining (USM), Abrasive Jet Machining (AJM), Chemical Machining (ChM), Electro-Chemical Machining (ECM), Electrical Discharge Machining (EDM).	**04**
		Additive Manufacturing (AM): Introduction and its industrial applications: Types of Liquid-Based AM Technologies, Solid-Based AM Technologies and Powder-Based AM Technologies.	**04**

Total =48

Recommended Books:

1. K.G. Budinski, M.K. Budinski, Engineering Materials Properties and Selection, 6th edition, Prentice Hall International, Inc.,
2. C.E. Harper, Handbook of Materials for Product Design, McGraw-Hill,
3. J. F. Shackelford, Introduction to Materials Science for Engineers, Prentice-Hall, India.
4. D.S.Clark and W.R. Varney, Physical Metallurgy for Engineers, CBS.
5. T.V.Rajan, C.P.Sharma, and A. Sharma, Heat Treatment Principles and Techniques, Prentice-Hall.
6. J.S.Campbell, Principles of Manufacturing Materials and Processes, Tata McGraw Hill.
7. P.N. Rao, Manufacturing Technology (Foundation Forming & Welding), Tata McGraw Hill.
8. P.C.Pandey and H.S.Shan, Modern Machining Process, Tata McGraw Hill.
9. B. Bhattacharyya and B. Doloi, Modern Machining Technology**:** Advanced, Hybrid, Micro Machining and Super Finishing Technology, Academic Press **(**Elsevier).
10. A. Gebhardt, Understanding Additive Manufacturing, Hanser Publishers.,
11. I. Gibson, D. Rosen, B. Stucker, Additive Manufacturing Technologies, Springer.

Subject Code **: MDME-611**
Title of the course **: Thermal Engineering and Fluid Mechanics**

L	T	P	Credits	Weekly Load
3	**1**	**0**	**4**	**4**

COURSE OUTCOMES:
After successful completion of course, the students should be able to

CO1: Learn and apply basic concepts and laws of thermodynamics.
CO2: Formulate the different cycles for the solution to simple and complex engineering problems w.r.t society and environment.
CO3: Design the heat and refrigeration systems in various industrial applications using modern tools.
CO4: Understand and apply the principles of submerged and floating bodies in fluid.
CO5: Understand the kinematics and dynamics of fluid flow and apply in various industrial problems.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	1	1	1	-	-	1	2
CO2	1	2	3	3	2	3	3	2	2	2	2	2
CO3	2	2	3	3	3	2	2	2	2	2	2	2
CO4	3	3	1	1	-	1	1	1	-	-	1	2
CO5	3	3	3	3	3	3	3	2	2	2	2	2
Avg.	2.4	2.6	2.2	2.2	2.7	2.0	2.0	1.6	2.0	2.0	1.6	2.0

Theory

	Main Topic	Description	Lecture
Unit-I	**Basic Concepts of Thermodynamics**	Relevance and need of thermodynamics in engineering, Laws of thermodynamics and Carnot cycle.	**02**
	Internal Combustion Engines	Introduction, classification, and engine components. Working principles of 2-stroke and 4-stroke engine, Gas power cycles, Otto cycle, Diesel cycle, Dual cycle.	**10**
	Heat Transfer, Refrigeration, and Air Conditioning	Introduction, Different modes of heat transfer and its applications. Introduction and working of refrigeration systems via Vapour Compression Refrigeration cycle. Refrigerants: types, uses, and their limitations. Introduction to air conditioning, Properties of atmospheric and moist air, Psychrometric processes and use of charts.	**12**
Unit-II	**Fundamentals of Fluid mechanics**	Introduction, basic concepts, fluid properties	**04**
	Fluid Statics	Fundamental equation of fluid statics, pressure and its measurement, buoyancy, centre of buoyancy, metacentre, metacentric height, hydrostatic thrust on submerged bodies	**04**
	Kinematics of fluid	Fluid flow and its classifications, motion of fluid particle along a curved path, velocity and acceleration of fluid particle, rate of discharge, continuity equation in differential form, velocity potential, rotation, circulation, vorticity, stream lines, path lines, streak lines, stream function, conservation of momentum- equation of motion and momentum theorem	**06**
	Dynamics of fluid flow	Fluid dynamics, control volume and control surface, energy and its different form used in fluid mechanics, Euler's equation of motion along a streamline, Bernoulli's theorem, application of Bernoulli's theorem	**06**
	Fluid Machinery	Introduction, working, and applications of turbines, pumps, and other hydraulic machines	**04**

Total=48

Reference Books:

1. Nag P.K. Engineering Thermodynamics, Mc. Graw Hill.
2. Yadav R., Thermodynamics and Heat Engines, Central Publishing House, Allahabad.
3. Yunus Cengel and Mike Boles, Thermodynamics, McGraw Hill.
4. Mathur & Sharma, I.C. Engine, Dhanpat Rai & Sons.
5. J.P. Holman, Heat Transfer, TMH
6. Cenegal, Fluid Mechanics, McGraw Hill
7. D. S. Kumar, Fluid Mechanics & Fluid Machinery, Kataria & Sons
8. Munson , Fundamentals of Fluid Mechanics, John Wiley & Sons
9. C.P. Arora Refreigration and Air conditioning, TMH.

Title of the course **: Fundamentals of Mechanical Design**
Subject Code **: MDME-621**

L	T	P	Credits	Weekly Load
3	**1**	**0**	**4**	**4**

COURSE OUTCOMES:

After successful completion of course, the students should be able to

CO1: Learn about the mechanism of different machines, gears, gear trains and its applications.

CO2: Understand the behavior of solids under various types of loads and stress and strain conditions.

CO3: Analyse the temporary and permanent joints such as welding riveted joint, and their design joints based on applications.

CO4: Design and analyze shaft, and keys.

CO5: Understand the concept of bearing and its types.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):												
Cos	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	2	1	1	2	1	1
CO2	3	2	3	3	2	2	1	1	1	1	1	1
CO3	3	3	3	3	2	1	1	1	1	1	1	1
CO4	3	3	3	3	2	2	1	1	1	1	1	1
CO5	3	2	1	2	2	1	2	1	1	1	1	1
Avg.	3	2.6	2.4	2.8	2	1.6	1.4	1	1	1.2	1	1

Theory

Unit	Main Topics	Course outlines	Lecture
Unit-I	**Mechanisms and Simple Machines**	Introduction to Mechanisms and Machines. Introduction to Cam and Follower arrangement. Introduction to Gear and Gear Train. Law of Gearing. Types of Gear. Types of Gear-train (Simple, Compound, and Reverted).	**06**
	Stress and strain	Introduction to stress and strain, stresses and strains in circular bars subjected to axial loading. Two-dimensional stress at a point on a plane, Principal stresses, and principal planes. Compression test, impact test, torsion and bending test. Mohr's circle	**08**
	Bending of beams and torsion of shafts	Types of loadings and supports for Beams (determinate). Shear Force diagram (SFD) and Bending Moment diagram (BMD). Introduction to pure bending of beams and bending stresses. Introduction to torsion of shafts and shear stress. Equivalent bending moment and equivalent twisting moment.	**08**
	Struts and columns	Difference between struts and columns, buckling of columns, Euler's theory of columns, Slenderness ratio. Equivalent length (Introduction of terms only)	**02**
Unit-II	**Design Fundamentals**	Introduction to design procedure, design requirements, factor of safety, stress concentration. General design considerations like fatigue, creep, fabrication methods, economic considerations, material selection and ergonomics.	**04**
	Temporary and Permanent Joints	Introduction to different types of joints. Type of riveted joints. Possible failure of riveted joints. Strength and efficiency of Butt and Lap riveted joints.	**08**

		Types of welded joints. Parallel and Transverse fillet welded joint, Design for V-butt welded joints.	
	Keys and shafts	Function of keys, types of keys, design of keys; square and flat key. Design of solid and hollow shaft.	**08**
	Bearings	Introduction, classification and selection of bearings	**04**

Total=48

Recommended Books:

1. Beer & Johnston, Engineering Mechanics (Static & Dynamics), McGraw Hill.
2. Ghosh, A., and Mallik, A.K., "Theory of Mechanisms and Machines", 2nd Ed., Affiliated East-West Press, 2003.
3. Hannah, J., and Stephens, R.C., "Mechanics of Machines: Elementary Theory and Examples", 4th Ed., Viva Books, 2004.
4. Pytel A H and Singer F L, Strength of Materials, Harper Collins, New Delhi.
5. Ryder G.H, Strength of Materials, ELBS
6. Crandall & Dahl, An Introduction to the Mechanics of Solids, McGraw Hill
7. Shigley, J.E., and Mischke, C.R., "Mechanical Engineering Design (in S.I. Units)", 6th Ed., Tata McGraw-Hill, 2006.
8. Juvinall, R.C., and Marshek, K.M., "Fundamentals of Machine Component Design", 4th Ed., John Wiley & Sons, 2006.
9. Norton, Machine Design-An Integrated Approach, Pearson Education.
10. Mahadevan, K., and B., Reddy, "Design Data Handbook", CBS Publishers, 2003.

Subject Code : **MDME-711**
Title of the course : **CAD/CAM & Robotics**

L	T	P	Credits	Weekly Load
3	1	0	4	4

COURSE OUTCOMES:

After successful completion of course, the students should be able to

CO1: Obtain knowledge and understand the basic concepts of industrial robotics, namely in terms of classification, kinematics, sensors, and typical applications.

CO2: To acquire the knowledge on advanced algebraic tools for the description of motion

CO3: Enhance the knowledge of application of computers in designing.

CO4: Understand the knowledge related to the use of computers in manufacturing.

CO5: Ability to Program industrial robots and CNC Machines.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	2	2	1	2	1	2	3
CO2	3	3	3	2	3	2	1	1	2	1	1	3
CO3	3	2	1	2	2	2	2	1	2	1	1	3
CO4	3	3	1	2	2	2	2	1	2	1	2	3
CO5	2	1	1	2	2	3	2	3	2	1	2	3

Theory:

	Main Topic	Description	Lectures
Unit-I	**Fundamentals of CAD/CAM**	Introduction to CAD and CAM. Definition of CAD and CAM tools. Applications of CAD/CAM. Design process and application of computers in design. Creating Manufacturing database. Benefits of CAD/CAM.	**04**
	Curves, Surfaces and Solids	Introduction to Parametric and non-parametric curves. Introduction to Surfaces and their types. Introduction to solid models.	**08**
	Fundamentals of Computer Numerical Control	Principles of NC, Classification of NC: Motion control, control loops, positioning systems, NC, CNC, DNC, Combined CNC/DNC systems. Tooling for NC machines: automatic tool changes, multiple pallets. Introduction to the role of computers in QC, Group technology, Computer aided process planning (CAPP), FMS	**08**
	NC Part Programming	Computer assisted part programming, Simple program. APT, CNC programming.	**04**
Unit- II	**Basics of Robotics**	Evolution of robot and robotics, laws of robotics, robot anatomy: Links, joints, Degrees of freedom (DOF), Precision movement, robot specifications and work volume, Types of Robot drives-Basic robot motions, Arm configuration, wrist configuration.	**04**
	End Effectors, Sensors and Robot Actuation	End effectors classification-Mechanical, magnetic, vacuum and adhesive gripper, Robot control-unit control system concept-servo and non-servo control of robot joints, adaptive and optimal control. Sensor devices Types of sensors- contact, position and displacement sensors, Force and torque sensors, Robot vision systems. Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.	**08**
	Kinematics of Robotics	Introduction to Forward and Inverse kinematics, Kinematic relationship between adjacent links, Denavit- Hartenberg notation and manipulator transformation matrix.	**08**

		Linear and angular velocity of a rigid body, velocity propagation along links, manipulator Jacobian	
	Robot Programming and Applications	Robot language classification-programming methods off and online programming, Lead through method, Teach pendant method. Applications of Robots in Industry, Role of Robotics in Industry 4.o	**04**

Total=48

Recommended Books:

1. Mittal and Nagrath, Robotics and Control, TMH.
2. J.J. Craig, Introduction to Robotics, Pearson Education.
3. S.R.Deb & S. Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hil
4. Michael E. Mortension ,Geometric Modeling, John Wiley.
5. Zeid, I., CAD/CAM, McGraw Hill (2008).
6. Groover & Zimmer, Automation, Production Systems and CIM, PHI
7. Chang, Wysk and Wang, Computer aided manufacturing, PHI
8. Kundra, Rao, Tiwari, Numerical Control and Computer Aided Manufacture, Tata Mc Graw Hill

Title of the course **: Industrial Engineering**
Subject Code **: MDME-721**

L	T	P	Credits	Weekly Load
3	**1**	**0**	**4**	**4**

COURSE OUTCOMES:

After successful completion of course, the students should be able to

CO1: Know the basic concept of Industrial engineering.
CO2: Learn method study and time study techniques.
CO3: Learn the quality control, value engineering and production, planning and control methods.
CO4: Learn practical applications of inventory control models.
CO5: Develop numerical solving ability for optimum utilization of resources

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	2	2	1	2	1	1	1
CO2	3	2	2	3	1	2	2	1	2	1	1	1
CO3	3	2	2	2	2	2	2	2	2	2	2	1
CO4	3	3	3	3	2	1	1	1	1	1	1	1
CO5	3	3	3	3	3	2	2	2	2	1	1	2
Avg.	3	2.2	2.4	2.4	1.8	1.8	1.8	1.4	1.8	1.2	1.2	1.2

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-I	**Basics of Industrial Engineering**	Industrial Engineering (IE), Definition and various applications of IE, Production/Service System, Productivity, Productivity Index, Types of productivity, Efficiency and Effectiveness.	**5**
	Quality Assurance	Need and importance of Quality, various Control Charts, Sampling, Acceptance Quality Level (AQL), Producer's Risk, Consumer's Risk, Operating Characteristic Curve, Introduction to 5S, Lean Manufacturing, Six sigma and TQM	**7**
	Work study	Introduction to Work Study: Time study and method study, Method Study Procedure, Recording techniques: Charts, and Diagrams, Critical Examination, Principle of motion economy, Micro motion study. Introduction to various work measurement techniques: Stop-watch time study, Work sampling, Pre-determined Motion Systems (PMTS). Types of work elements, guidelines for breaking the job into various work elements. Rating: Definition, Types of rating Techniques, Allowances. Introduction to **Ergonomics**: Principles and Design	**12**
Unit-II	**Production Planning and Control (PPC)**	Objectives, Components and Phases of PPC, Process Planning, Steps in Process Planning for Flow Shop Scheduling, Sequencing. Types of Scheduling Systems, Master Scheduling, Order Scheduling, Comparison between Production Planning and Production Control.	**10**
	Value Engineering (V.E.)	Concept of value engineering, Aim and objectives, Phases in value engineering, Principles of Value Analysis, Test for value analysis. Difference between V.E. and Cost Reduction Techniques, Functional Analysis System Techniques (FAST),	**6**

	Inventory Control & Management	Inventory, Deterministic model of Economic Order Quantity (EOQ), Selective Inventory Control, MRP, Just in Time (JIT), Kanban etc., Basics of ERP and Supply Chain Management.	**8**

Total=48

Recommended Books

1. A. Barnes; Motion and Time Study John Wiley & sons Publication.
2. Dalela and Sourabh;Work Study and Ergonomics Standard Publishers
3. Ronald Mayer;Production Management TMH Publication.
4. MartandTelsang Industrial Engineering & Management S.Chand Publication.